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Sensitivity of accumulated rainfall and errors estimates to the configuration of microwave imagers constellation for the tropical regions

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Over the intertropical belt, satellites are powerful tools to measure precipitation, as surface networks of rain gauges or radars are scarce over this part of the globe. Rainfall is central to the water and energy cycle of the Tropics and the upcoming GPM program offers a unique perspective on this important challenge. We explore here, via simulations, how sensitive are rainfall accumulation estimates to the design of the details of the observing system. The Megha-Tropiques TAPEER-BRAIN Level-4 product is considered for this study. TAPEER-BRAIN is a technique that builds rainfall accumulation estimations and associated error at the one-degree/one-day scale over the whole Tropical belt. TAPEER-BRAIN relies on the use of infrared imagers onboard a fleet of geostationary satellites and Level-2 instantaneous rainfall estimates derived from passive microwave radiometers onboard a constellation of low Earth orbiting satellites. An error model involving rainfall auto-correlation calculations is then used to characterize sampling uncertainties on accumulated precipitation estimations. This framework is used to simulate the various configuration of the observing system. To this end, Level-2 instantaneous rain products are simulated through the use of an orbit simulator and a sampling method. Rainfall estimations are extracted from the GSMaP rainfall product under the swath of simulated observing systems. One-degree/one-day rain and error estimations are then computed with infrared data and the simulated Level-2 instantaneous rain products for different scenarios of constellation. Sensitivities to the sampling of sun-synchronous satellites as well as observing systems on low-inclination orbits are performed. One of the main findings of this study is that satellites on "tropical" orbits have a high contribution to the improvements of TAPEER-BRAIN quantitative precipitation estimations (rain and error estimations). This study also shows that satellites with local Equator crossing times separated of durations close to rainfall auto-correlation periods do not contribute to improvements of rain and error estimations. This methodology should be useful to evaluate the expected performances of the upcoming rainfall space based observing system.